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SYMPOSIUM

Self-employment rates and business size: the roles of occupational choice and credit market frictions

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Abstract Self-employment rates and project size vary greatly across countries. The main message of this paper is that these broad regularities are consistent with an environment in which a common self-employment technology is available worldwide, but where (a) financial intermediation costs and (b) alternatives in "paid" work differ greatly. Our model indicates that alternatives in paid work are crucial for explaining self-employment *rates*, whereas high financial intermediation costs primarily affect the *scale* of projects. We also show that credit use is not informative for predicting either rates of self-employment or the scale of self-employment projects.

Keywords Self-employment · Project scale · Development

JEL Classification J23 · E21 · D31

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1 Introduction

Self-employment activity varies substantially across nations. For example, the fraction of the labor force that is self-employed has been measured at approximately 8% in the US, 44% in Greece, and 51% in the Philippines (see, e.g. Gollin 2008). Even within sectors, there is significant variation in self-employment rates across countries. For instance, in Ghana, Bangladesh, and Nigeria, the self-employment rate in manufacturing reaches 80% of workers, compared with fewer than 2% in the United States. Blanchflower (2008) reports similar evidence by comparing OECD countries. Furthermore, Gollin (2002) finds that worldwide, there is a strong negative relationship between per-capita income levels and self-employment rates even within sectors. By contrast, establishment size has a strongly positive correlation with per-capita income. In early work, Kuznets (1966) and Lucas (1978) noted that average business size grows with overall development. More recently, estimates of Tybout (2000) and Quintin (2008a) show that establishment size for a large number of sectors in Mexico is smaller than that in the US.

The average cost of intermediating varies substantially across countries. Erosa (2001), for example, finds that one unit of funds is nearly four times higher in poor countries than in rich ones.[1] It is also widely believed by policymakers that credit conditions are pivotal in self-employment decisions. Even in the U.S., where credit markets are well-functioning, especially relative to those in less developed countries (hereafter LDCs), public policy towards self-employment strongly emphasizes the need to supplement private financial intermediation. Notably, the U.S. Small Business Administration exists solely for the purpose of boosting credit access to the would-be self-employed. To the extent that credit is important in self-employment decisions, the relatively high credit costs observed in LDCs *are* consistent with small business size in LDCs, but raise the question of why we observe relatively high self-employment *rates* in LDC's.

The preceding observations are therefore not trivial to reconcile; financial frictions are alleged to matter for self-employment, and yet, self-employment rates are much higher in precisely those countries where these frictions are the largest. In other words, if credit costs help account for cross-country variations in business size, why don't they help account for high LDC self-employment rates? In this paper, we propose a quantitative theory that combines the role played by financial frictions with a second, potentially key ingredient: occupational choice. Specifically, we emphasize the fact that self-employment decisions are made in response to not only credit, but also to the relative attractiveness of alternative labor market opportunities, especially those presented by the option of "paid-work." Our model is one where the extensive margin

[1] Two underlying sources of higher credit costs are: (1) enforcement-related costs, and (2) taxes on financial intermediation. As an example of the former, Djankov et al. (2002) report that it takes about 300 days to collect on a bad check on average in Argentina, compared to only 50 days in the U.S. As an example of the latter, Erosa (2001) reports that in 1984, tax policies of the Philippine government created a wedge of 12 percentage-points for loans over the risk-free rate. Similarly, Chamley and Honohan (1990) estimate that total financial intermediary taxation was 7% of GDP in a sample of African countries. If these impediments on financial contracting increase the cost of credit, we should expect less self-employment in these countries, all else equal (see Banerjee and Newman 1991; Quadrini 2000).

of self-employment is allowed to be strongly influenced by alternatives in paid-work, while credit costs can play an important role in the intensive margin, i.e. business size.

An obvious observable measure of labor market opportunities lies in average wages. The large disparity in wages between the U.S. and LDCs then suggests that observed differentials in self-employment rates are a natural result. However, to the extent that financial frictions are more severe in LDCs, the ability to start a business using external funds falls. In addition, low returns in "paid" work inhibit potential entrepreneurs from accumulating enough wealth to overcome financial frictions, further suppressing both the self-employment rate as well as project size. In sum, financial frictions and low wages seem capable of explaining both the high rate of self-employment and the smaller project size observed in LDCs.

Our work is most closely related to Gollin (2008), Antunes et al. (2008), Quintin (2008b). Gollin (2008) employs the Lucas "span-of-control" approach to evaluate the role of productivity growth on self-employment choices. In his model, capital accumulation generates wage growth, leading to lower self-employment rates and self-employment project size. However, his work abstracts from both credit market frictions and uncertainty, and therefore their interaction with wage growth. By contrast, our focus is precisely on the interaction between wage growth and credit market frictions when both labor income and self-employment income are risky. Our paper is also complementary to Antunes et al. (2008) in that we investigate the role of financial frictions in self-employment decisions. However, in contrast to these work of these authors, our focus is not on enforcement problems per se, but rather on the role played by alternatives to self-employment. Nonetheless, as in Antunes et al. (2008), the present work argues that intermediation frictions are secondary to other forces; in the former, intermediation frictions are secondary to enforcement frictions, while in our paper, they are secondary to wage alternatives in the "corporate" sector. Quintin (2008b) also informs the present work by studying a model endogenizing the size of the "informal sector," which for LDC data, may ultimately cover a significant fraction of the self-employed workforce. He argues that tax evasion is insufficient to account for a large informal sector in LDCs, while contractual imperfections are more powerful. Given this, we abstract from differences in taxation and its enforcement, and focus on intermediation costs directly.

Our study is one of quantitative theory, as we intend our results to be informative for understanding the relative strengths of two key determinants of self-employment behavior. However, we do not intend the model to be a definitive "case study" of cross-country differences, as nations differ along an enormous number of dimensions not modeled here. Nonetheless, our main findings do appear consistent with the stylized observations above.

Our model indicates that alternatives in paid work are crucial for explaining self-employment *rates*, whereas high financial intermediation costs primarily affect the *scale* of projects. Moreover, we find that high rates of self-employment do not imply well-functioning credit markets. In fact, we show that, given observed wage differentials in paid work, more severe frictions in financial markets are required to account for the stylized facts on relative self-employment rates and establishment size. We also show that the fact that self-employment projects are smaller in LDCs does not mean that self-employment technologies vary across countries. Rather, we find that under even relatively low wages, high transactions costs in financial intermediation substantially impede borrowing, and in turn, the scale of self-employment projects. With respect to credit markets, we find that the absence of borrowing does not imply inefficient production. Moreover, the converse is also true; when wages are low, many self-employed borrow, but run inefficiently small projects.

The remainder of the paper is organized as follows. Sections 2 and 3 present and parameterize the model; Sect. 4 reports and discusses results. Section 5 concludes.

2 Model

The model is based on the occupational choice framework used in Akyol and Athreya (2007), but differs along two key dimensions. First, in the latter, wages were held fixed throughout, ruling out the analysis of the role played by economywide changes in the alternatives to self-employment. Second, a main goal of the current study is to better understand the role of financial frictions arising from technological and tax considerations, while the focus of the latter was on the effects of default regulations. As argued in Akyol and Athreya (2007), default can provide insurance to borrowers, making a portion of borrowing costs payment for a form of insurance. Our approach here is aimed at allowing us to study the effects of impediments created by "pure" transactions-related costs, as opposed to premia arising from default-risk. In turn, we abstract from default and study instead the consequences of changes in the "spread" between interest rates on risk-free borrowing and savings.

2.1 Preferences

There is a continuum of ex-ante identical agents who maximize the expected utilities from consumption, and supply labor inelastically. All households begin life with zero wealth, work for J periods and then retire. Working age is indexed by $j = 1, 2, \ldots\ J$. There is a single consumption good. Consumption in age$-j$ is denoted by c_j. In each period, utility from consumption is governed by the function $u(.)$, which is strictly increasing and strictly concave. We denote wealth taken into retirement at age j by a_{J+1}. Resources sent into 'retirement' are valued according to the function $\phi(.)$. We assume that $\phi(.)$ is strictly increasing and strictly concave. Thus, given the discount factor $\beta_h \in (0, 1)$, households maximize:

$$E_0 \sum_{j=1}^{J} \beta_h^{j-1} u(c_j) + \phi(a_{J+1}). \tag{1}$$

2.2 Occupational choice

Households choose in every period between being a worker or an entrepreneur. A household first draws a realization of stochastic productivity in paid/corporate-sector work, and therefore knows the value of paid work. If instead, they choose to operate a self-employment project, they face a known probability distribution of entrepreneurial productivity. Both entrepreneurial and corporate-sector productivity are increasing functions of human capital, denoted by h. Human capital is exogenously determined prior to the first period of the agent's working life, and generates permanent productivity differences between agents. Human capital may be interpreted as an agent's education level, e.g. college graduate versus non-college graduate. Therefore, a useful interpretation of h, when it is employed in entrepreneurial activity, is that it captures the ability of college-educated agents to generate and execute productive ideas for an entrepreneurial project.

2.2.1 Paid work

Paid work and is also risky, age-dependent, and not directly insurable. Incorporating a life-cycle profile and realistic uninsurable wage risk are both important, as the role played by frictions in credit markets will depend on the wealth held by households. Wealth, in turn, is affected both by age, and the attempts of households to self-insure. Labor productivity is age-j, denoted, ϵ^j, takes on values in a finite set, i.e. $\epsilon^j \in \{\epsilon_1^j, \epsilon_2^j, \dots \epsilon_N^j\}$, for $j = 1, \dots, J$. In each period a shock is drawn according to the age-dependent probability distribution $g_j(\epsilon)$. We denote the mean level of corporate sector productivity at age-j, for human capital h, by $\mu^{\text{Corp}}(j, h)$. Our specification of $g_j(\epsilon)$ captures variations in the life-cycle path of productivity in paid work, as widely documented (see, e.g. Hansen 1993). The labor income of an agent is then given by $\epsilon_n \mu^{\text{Corp}}(j, h)$.

2.2.2 Self-employment

Those who choose entrepreneurship operate a stochastic production technology $\mathcal{F}(.)$ that depends on the productivity shock, θ, and capital stock, k. Entrepreneurial productivity takes values in a finite set, i.e. $\theta \in \{\theta_1, \dots, \theta_N\}$, and has a human capital-specific probability density function given by $\pi_h(\theta)$. Project size, k, lies in the set $k = [0, \overline{k}]$ where $\overline{k}$ is an (endogenous) upper bound. As mentioned earlier, insurance against project risk is assumed unavailable. Moreover, we assume that productivity across salaried work and self-employment is uncorrelated, which keeps the interpretation of model outcomes easier.

All households have access to the same self-employment technology, though productivity does depend on human capital. Thus, we set the random variable for productivity θ, and returns-to-scale parameter α, to the values calibrated in the benchmark model. That is, we assume that for small-scale operations typical of self-employment, the available technology is common, i.e. "blueprints" for small-scale enterprises are available worldwide. This assumption reflects two goals. First, our approach does not introduce any additional unobservable heterogeneity into our model. Technology in general, and especially that used by the self-employed, is not directly observable. Second, following Parente and Prescott (2000), we associate differentials in TFP across nations as arising from specific policies applying primarily to the organized "corporate" sector, especially size-dependent policies applicable to the treatment of labor (see in particular Güner et al. 2008).[2] Our model therefore captures the incentives to choose self-employment that may arise in large part from the regulatory hurdles that effectively lower the payoff to "paid" corporate-sector work. Moreover, in related work, Herranz et al. (2008) argue for, and estimate the parameters of, a single common blueprint self-employment technology for US small businesses. Nonetheless, in Sect. 4.5, we will relax this condition and show that it does *not* help reconcile theory with cross-country data. In summary, we focus on accounting for differences in outcomes created by the most directly observable features of the household's environment: opportunities in "paid work," and the costs of financial intermediation.

2.2.3 Financial market arrangement

There is a competitive market for savings and loans. Let $R^f \equiv (1 + r^f)$ denote the gross risk-free interest rate on savings. Let τ denote proportional transactions costs associated with the intermediation of funds. A primary focus of the paper is on the impact of this cost on self-employment and credit-market outcomes. The interest rate on loans is therefore $R^l = R^f + \tau$.

Those who choose self-employment may finance the project with any internal wealth $a \geq 0$, or through external borrowing $b \geq 0$. To capture the uninsurable nature of self-employment income, equity contracts are assumed to be unavailable. Given the discount rate, a bond issue of face value b generates a loan of b units of capital. The entrepreneur's project size is simply the sum of the loan and internal funds, whereby $k \equiv a + \frac{b}{R^l}$. The entrepreneur observes the productivity realization θ which determines output. The loan b must be repaid, after which the household divides remaining resources by choosing current consumption c_j and wealth a_{j+1} for the next period. The timing is summarized in Table 1.

The household's incentives to save for retirement are governed by the function $\phi(.)$. After age J, the household retires; each retiring household is then replaced by the next generation, which holds zero wealth. These households also realize a human capital level h' according to the function $\varsigma(h'|h)$, where h' depends explicitly on h, parental human capital.

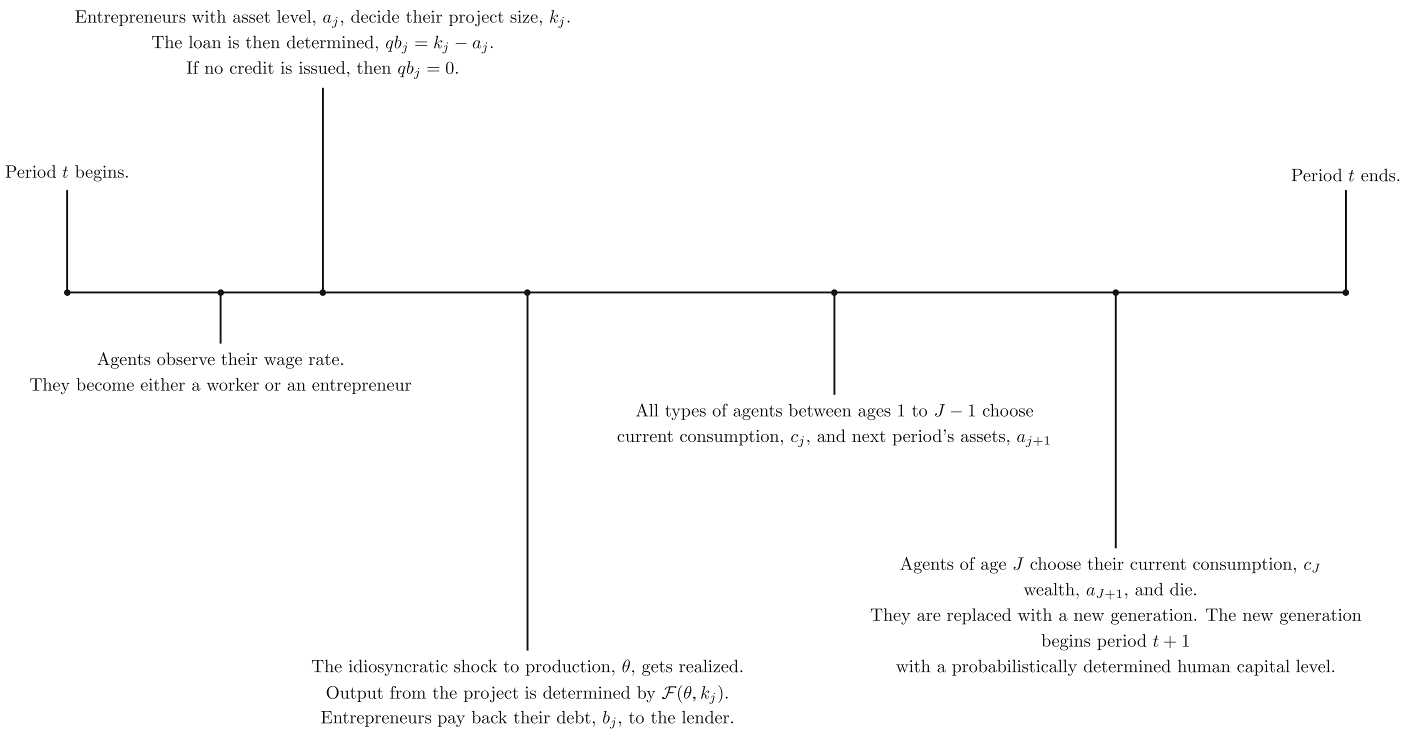
2.3 Recursive formulation

At the beginning of any period, $S = \{a, j, \epsilon_n^j, h\}$ denotes the state of the household, and $V(S)$ is the value of entering a period with state S. The state vector gives a household's current level of assets a, age j, and current corporate-sector wage $\epsilon_n^j h$. Let V^e denote the option value of being an entrepreneur and V^w the value of being a worker. Optimal occupational choice then implies that $V(S)$ must satisfy:

$$V(S) = \max\{V^e(S), V^w(S)\}, \tag{2}$$

[2] Parente and Prescott (2000) note that in India, for example, firing costs grow rapidly and non-linearly with the size of the labor force employed in a production unit.

Table 1 Sequence of events in a given period



Let $I(S)$ be the indicator function associated with (2), such that

$$I(S) = \begin{cases} 1 & \text{iff} \quad V^e(S) > V^w(S) \\ 0 & \text{iff} \quad V^e(S) \leq V^w(S). \end{cases} \tag{3}$$

Self-employed/entrepreneur Given an initial wealth level a, age j, and a current corporate-sector wage level $\epsilon_n^j h$, the agent faces an interest rate R^l when choosing the face value of debt b optimally, which in turn determines the size of the project according to $k = b + \frac{a}{R^l}$. Therefore, the ex-ante value of choosing entrepreneurship in the current period, $V^e(S)$, is given by:

$$V^e(S) = \max_{b_j \geq 0} E_\theta \; W(S, b_j, \theta). \tag{4}$$

For any realization of the productivity shock θ, let $W(S, b_j, \theta)$ be the maximal value attainable for an age-j household whose beginning-of-period state is S, who has chosen to borrow b_j units, and who then receives productivity θ. Therefore, we have:

$$W(S, b_j, \theta) = \max_{a_{j+1}} \{u(c_j) + \beta_h EV(S')\}, \tag{5}$$

$$\text{such that} \quad c_j + \frac{a_{j+1}}{R^f} \leq \mathcal{F}(\theta, k_j) - b_j, \tag{6}$$

$$k_j = a + \frac{b_j}{R^l}, \tag{7}$$

$$k_j > 0, \quad c_j \geq 0, \quad a_{j+1} \geq 0, \quad b_j \geq 0, \quad \forall \; j = 1, \; J-1. \tag{8}$$

In age J, households considering self-employment solve a similar optimization problem faced by entrepreneurs at other ages except that they use the expected continuation values given by $\phi(.)$, i.e.

$$W(S, b_J, \theta) = \max_{a_{J+1}} \{u(c_J) + \phi(a_{J+1})\}. \tag{9}$$

Worker The recursive problem facing a worker in the "corporate" sector is a simple consumption savings problem in which we assume that workers must hold non-negative assets. This yields the recursion:

$$V^w(S) = \max_{a_{j+1}} \{u(c_j) + \beta EV(S')\}, \tag{10}$$

$$\text{such that} \quad c_j + \frac{a_{j+1}}{R^f} = \epsilon_n \mu^{\text{Corp}}(j, h) + a_j, \tag{11}$$

$$c_j \geq 0, a_{j+1} \geq 0, \quad \forall \; j = 1, \; J-1. \tag{12}$$

In age J, as above, the continuation value is given by $\phi(.)$, which implies that the worker's value is:

$$V^w(S) = \max_{a_{J+1}} \{u(c_J) + \phi(a_{J+1})\}. \tag{13}$$

2.4 Equilibrium

Optimal behavior by households, for given prices and parameters, is defined by the decision rules governing occupational choice, borrowing, consumption, and savings. These are denoted by $I(S)$, $b(S)$, $c(S;\theta)$, and $a'(S;\theta)$, respectively. The equilibrium concept we use is standard Stationary Recursive Competitive Equilibrium (SRCE).

Given the individual state space S, we can define $X = [0,\infty) \times \{1, 2, \ldots\ J\} \times \{\epsilon_1^j, \epsilon_2^j, \ldots\ \epsilon_N^j\} \times \{h_1, h_2\} \times \{\theta_1, \ldots, \theta_N\}$. Let $(X, \mathbb{B}(X), \omega)$ be a probability space where $\mathbb{B}(X)$ is the Borel $\sigma-$algebra on X, and ω is the measure of agents on the state space. Thus, for each $\mathcal{C} \in \mathbb{B}(X)$, $\omega(\mathcal{C})$ is the fraction of agents whose individual states lie in $\mathcal{C}$. The individual agent's policy functions, which solve the dynamic program, along with the stochastic process of endowments, induce a stochastic process for the individual's state. This process describes the evolution of occupation, borrowing, and asset holdings according to a transition function $P(x, \mathcal{C})$, $\forall\, \mathcal{C} \in \mathbb{B}(X)$. The transition function in turn implies a stationary probability measure $\omega^*(\mathcal{C})$ for all $\mathcal{C} \in \mathbb{B}(X)$, which must satisfy the fixed point property:

$$\omega^*(\mathcal{C}) = \int_X P(x, \mathcal{C}) \mathrm{d}\omega^*. \tag{14}$$

More precisely, the equilibrium is defined as follows:

Definition 1 Given a risk-free interest rate on deposits, R^f, a transaction cost on intermediation, τ, and human capital transitions across generations, $\varsigma(.)$, a stationary *recursive (partial) equilibrium* for this economy consists of (1) decision rules $\{I(S), b(S), c(S;\theta), a'(S;\theta)\}$ for occupational choice, borrowing, consumption and savings respectively, (2) value functions (2)–(13), and (3) a stationary joint distribution ω^* of households over asset, wage and productivity levels; such that

1. Decision rules $\{I(S), b(S), c(S;\theta), a'(S;\theta)\}$ solve the dynamic program following (2).
2. Distributions are stationary and consistent with individual optimal choices as described in (14).

Our partial equilibrium approach is motivated by two considerations. First, from any given household's perspective, it is wages in paid work relative to income in self-employment that governs occupational choice. Our experiments therefore directly yield the effect of equilibrium wages on self-employment decisions. Second, in order to understand the effects of wages on self-employment behavior, one approach would be to alter total factor productivity, and then derive equilibrium wage and self-employment responses. However, this approach requires us to take a stand on wage determination. Our emphasis on the life-cycle makes the relevant mapping one from TFP to wages over the entire life-cycle. The latter is something which clearly hinges on the extent to which labor contracts are continuously set in spot markets, or reflect other, longer-term relationships.

Unlike wage levels, transactions costs of intermediation are not themselves endogenous variables. Therefore, variations in these costs may influence equilibrium wages,

Table 2 Parameters

Preferences		
$\{\beta_c, \beta_{hs}\}$	$\{0.985, 0.970\}$	Calibrated
$u(c) = \frac{c^{1-\xi}}{1-\xi}$	$\xi = 2$	Calibrated
$\phi(a_{J+1}) = \psi_h \frac{a_{J+1}^{1-\rho}}{1-\rho}$	$\rho = 2, \psi_h = \{\psi_c, \psi_{hs}\} = \{15, 7.5\}$	Calibrated
Labor Productivity		
$h = \{h_c, h_{hs}\}$	$\varsigma(h' = h_c \vert h = h_c) = 0.61,$	
	$\varsigma(h' = h_c \vert h = h_{hs}) = 0.21$	Calibrated
$\mu^{\text{Corp}}(j, h)$	Calibrated	Hansen (1993)
Entrepreneurial Production		
$\mathcal{F}(.) \equiv \theta k^{\gamma} + (1-\delta)k$	$\gamma = 0.75, \delta = 0.11$	Calibrated
$\log\theta \sim N(\mu_{\theta_h}, \sigma_{\Theta_h})$	$\mu_{\Theta_c} = -1.35, \sigma_{\Theta_c} = 0.83.$	Calibrated
$h = \{c, hc\}$	$\mu_{\Theta_{hs}} = -1.44, \sigma_{\Theta_{hs}} = 0.83$	Calibrated
Credit Markets		
q^f	0.96	Mehra and Prescott (1985)
τ	0.0225	Calibrated

and equilibrium self-employment decisions. However, such changes make it difficult to isolate the direct effect of transactions costs from the indirect effect coming from changes in equilibrium wages. We therefore find the transparency of partial equilibrium to be more instructive.

3 Parameters

We calibrate our benchmark model to match three sets of observations for the US economy: (1) the rate of self-employment of both college and non-college-educated over the whole life-cycle, (2) the median wealth of households over the life-cycle, and (3) the income of both college- and non-college educated *workers* over the working-life. These targets ensure that our model delivers a plausible approximation to occupational choices in response to variations in internal wealth and wage opportunities in the corporate sector. All parameters are listed in Table 2, and both benchmark outcomes and their empirical counterparts are presented in Figs. 1, 2, and 3. As seen in the Figures, the benchmark does well in tracking occupational choice, wealth and labor income over the life-cycle.

3.1 Skills

Human capital takes two levels, representing college-educated and non-college-educated households respectively, and is denoted by $h = \{h_c, h_{\text{nc}}\}$. As stated above, in the benchmark model, we identify the underlying skill composition by educational attainment in the US. In the experiments, however, we assume that this skill composition is invariant across wage levels and transactions costs. Nonetheless, our results are

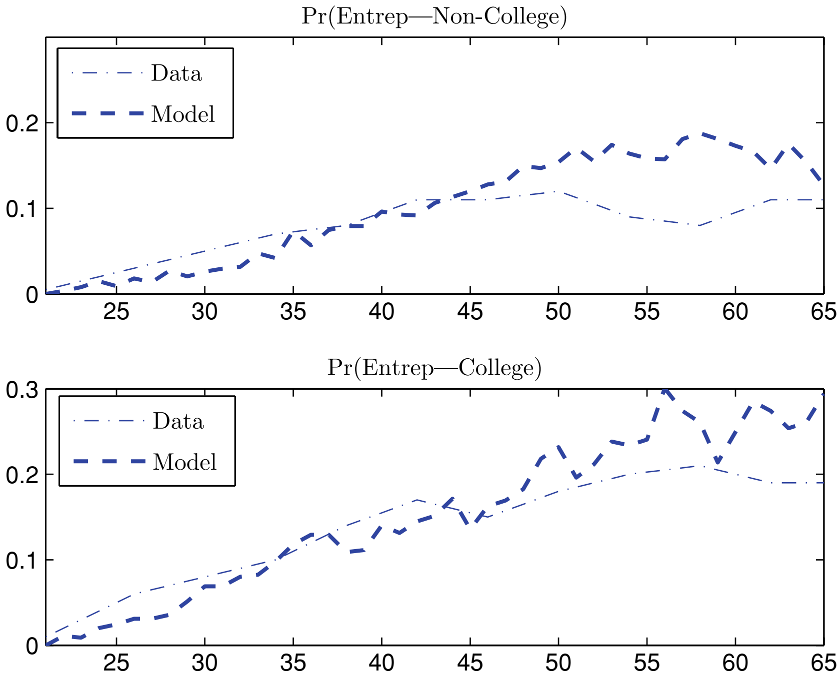


Fig. 1 Age distribution of self-employment rate

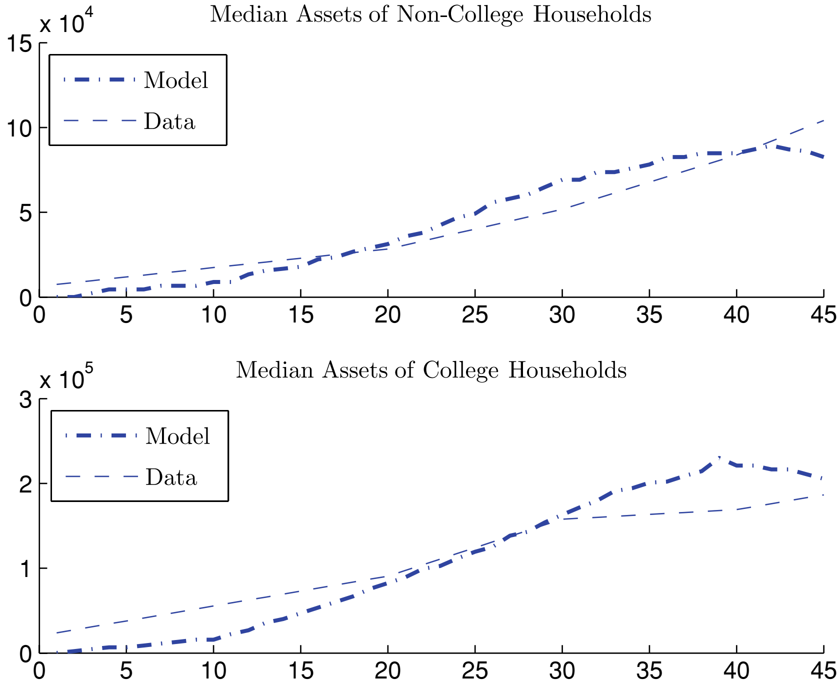


Fig. 2 Median wealth

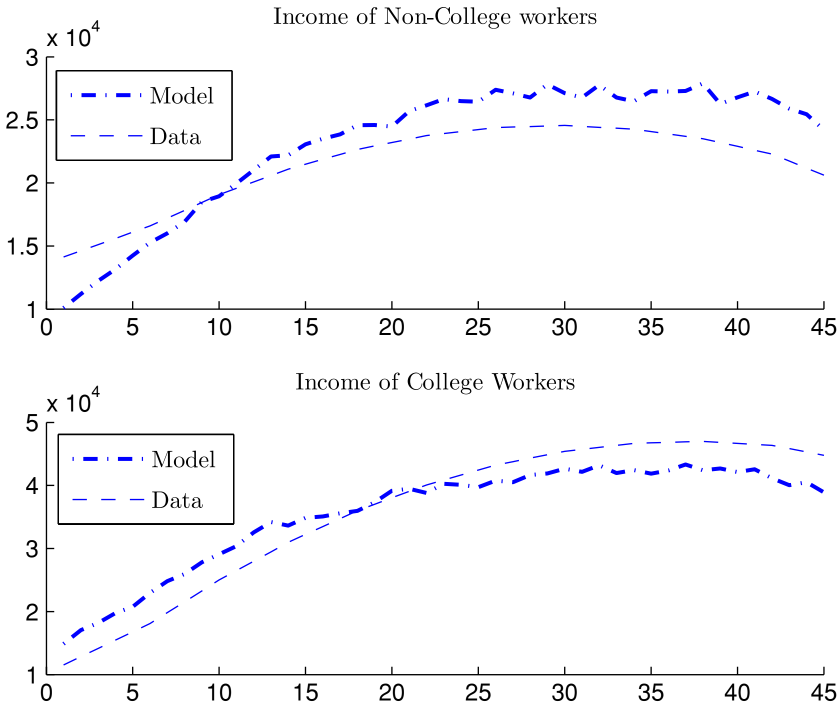


Fig. 3 Income of workers

likely to be quite robust along this dimension for two reasons. First, our results with respect to behavior within a given skill group *cannot* be affected as all generations start working-life with zero wealth. Second, our results make clear that the changes in self-employment decisions for each skill group across different wage and intermediation costs are very similar, rendering population weights relatively unimportant. We therefore set transition probabilities across generations at $\varsigma(h' = h_c | h = h_c) = 0.61$, and $\varsigma(h' = h_c | h = h_{nc}) = 0.21$, respectively.[3] These probabilities allow us to match the fractions of US college-educated households (35%), and US high-school educated households (65%) reported in Terajima (2004).

3.2 Preferences

All households have within-period utility given as:

$$u(c) = \frac{c^{1-\xi}}{1-\xi} \quad \text{if} \quad \xi > 1, \tag{15}$$

[3] Given the absence of altruism, the intergenerational human capital transition probabilities do not alter decisions, and are only required to generate the correct fractions of college- and non-college-educated households in the steady-state.

where ξ denotes the coefficient of relative risk aversion. We set ξ equal to 2, as is standard. The model period corresponds to one calendar year. Household preferences are heterogeneous along two dimensions, the discount factor β_h, and the valuation of resources taken into retirement ψ_h. We calibrate β_h to primarily influence the (human-capital-specific) age-profile of median US wealth. Our benchmark calibration sets $\beta_h = \{0.985, 0.970\}$ for college and non-college agents, respectively. We parameterize the retirement-wealth valuation function by the following.

$$\phi(a_{J+1}) = \psi_h \frac{a_{J+1}^{1-\rho}}{1-\rho}. \tag{16}$$

Given wealth accumulation patterns during working life, we calibrate $\psi_h = \{\psi_c, \psi_{nc}\}$ and ρ to approximate median wealth among retiring US households for college and non-college households, respectively. Our calibration yields the values $\psi_h = \{\psi_c, \psi_{\text{nc}}\} = \{15, 7.5\}$, and $\rho = 2$ for skilled and unskilled agents respectively. Though we do not report the results here, it is important to note that imposing homogeneity in these two parameters leads in our model to counterfactual implications for both relative wealth accumulation and self-employment decisions.

3.3 Productivity risk in paid work and self-employment

To parameterize age- and skill-specific life-cycle productivity risk, we first set mean productivity for skilled workers by linear interpolation of the estimates of Hansen (1993). Wage risk in the corporate sector is then parameterized by setting the standard deviation of shocks to approximate the (unconditional) cross-sectional variance of log-earnings as estimated by Hansen (1993). With respect to entrepreneurial production, we follow Polkovnichenko (2003) by assuming human capital is not occupation-specific and durable, in that it does not depreciate in the event of entry into or exits from entrepreneurship. We use Cobb-Douglas, as is standard (see, e.g. Cagetti and DeNardi 2006) for the entrepreneurial production technology, implying that gross output is simply: $\mathcal{F}(\theta, k) \equiv \theta k^{\gamma} + (1-\delta)k$. The production parameter γ is common to all entrepreneurial ventures, and is set to 0.75, close to the value in Cagetti and DeNardi (2006). Depreciation is set to $\delta = 0.11$. The specification of returns to scale is disciplined by its implications for project size. In particular, as γ approaches one, the technology approaches constant-returns-to-scale, whereby desired project size grows without bound and-in our model-generates counterfactually large self-employment projects. These counterfactually large projects imply counterfactually large borrowing by all but the oldest of households.

We follow Davis and Willen (2002) and impose zero correlation between the corporate-sector and entrepreneurial-sector productivity, and allow the distribution of shocks to the entrepreneurial project to be different across skill-levels. Productivity in self-employment is intertemporally i.i.d., and distributed $N(\mu_{\theta_h}, \sigma_{\theta_h})$. The assumption of intertemporally uncorrelated productivity in the self-employment sector is made primarily for computational ease. However, serial correlation, even if assumed, is unlikely to be very large, as the median length of self-employment spells in the data is short (i.e. typically less than 2 years), and is 1 year in our benchmark model. Our calibration targets are matched well by the following choices: $\mu_{\theta_c} = -1.35$, $\sigma_{\theta_c} = 0.83$ for skilled agents, while for unskilled households, we set $\mu_{\theta_{nc}} = -1.44$, and $\sigma_{\theta_{nc}} = 0.83$. The means for self-employment productivity turn out to be crucial for both entry and income of the self-employed. The variance of θ is set following the model of Akyol and Athreya (2007), which used information on default risk to calibrate the variability of returns to self-employment. The variability in paid-work is set primarily to match the overall cross-sectional variability of labor earnings.

For financial markets, we set the risk-free rate $R^f = 1.04$, following Mehra and Prescott (1985), and set the benchmark transactions cost at $\tau = 0.0225$. Our choice for the benchmark value for transactions costs in the US is also consistent with measures computed using direct bank income statement data from Demirgüç-Kunt and Huizinga (2000). Relatedly, Antunes et al. (2008) employ values ranging from 0.5 to 2.0%.

4 Results

Our goal is to understand the roles played by intermediation costs and the payoff from "paid work" on the rate and scale of self-employment. We report the outcomes from four classes of experiments aimed at isolating the contributions of the alternatives to self-employment and conditions in the loan market.

4.1 The role of intermediation costs

The first set of results, given in Tables 3 and 4, highlights the importance of financial frictions in self-employment outcomes. In particular, we study the effects of transactions premia on borrowing relative to the risk-free rate. We vary premia from a lower bound of $\tau = 0.0225$ (the current US level) and increase premia to $\tau = 0.15$, an upper bound motivated by the 12-percentage point premium obtaining in the Philippines, as reported in Erosa (2001). However, given that our model abstracts from default risk, it is important to keep in mind that such a value may truly represent an upper bound on the transactions costs of lending. Nonetheless, Demirgüç-Kunt and Huizinga (2000) report that fully collateralized loans are prevalent in some developing to such an extent that observed default rates and hence, default premia, are virtually zero.[4] In order to isolate the effects of financial market frictions, we fix the wage process throughout this set of experiments to current US levels. Therefore, this set of results is most informative about the importance of financial frictions on self-employment behavior for developed countries.

In Tables 3 and 4 we document that self-employment rates, borrowing, and project size all depend on the presence of premia on external finance. Specifically, there are large changes in the "extensive" margin, seen in the fall in overall self-employ-

[4] As a general matter, inferring the extent of frictions in lending is complicated by the possibility that the option to default may itself encourage borrowing and thereby self-employment, while simultaneously contributing to the cost of credit via default premia. See Akyol and Athreya (2007) and Antunes et al. (2008).

Table 3 The effect of transactions costs under US wages: extensive margin

	Transaction costs, τ ($\tau_{\mathrm{US}} = 0.0225$)				
	0.0225	0.05	0.075	0.1	0.15
Self-employment rate	0.12	0.10	0.092	0.091	0.09
Self-empl. rate | no-coll	0.10	0.08	0.07	0.07	0.07
Self-empl. rate | coll	0.16	0.14	0.1328	0.13	0.13
Probability of borrowing	0.51	0.22	0.09	0.03	0.00
Prob of borr | no-coll	0.56	0.26	0.10	0.03	0.00
Prob of borr | coll	0.40	0.15	0.07	0.03	0
Mean age of self-empl.	30.63	32.60	33.35	33.60	33.65
Mean age of self-empl. | no-coll	30.52	32.51	33.04	33.27	33.32
Mean age of self-empl. | coll	30.68	32.65	33.51	33.76	33.81

Table 4 The effect of transaction costs under US wages: intensive margin

	Transaction costs, τ ($\tau_{\mathrm{US}} = 0.0225$)				
	0.0225	0.05	0.075	0.1	0.15
Project size in $	182,920	161,310	157,080	155,790	155,780
Project size |no-coll in $	155,240	130,340	124,920	122,990	123,130
Project size |coll in $	237,430	222,310	220,430	220,410	220,110
Wealth |borrowing in $	82,790	55,490	40,610	27,420	n/a
Wealth |borr and no-coll in $	69,830	48,970	36,270	22,890	n/a
Wealth |borr and coll in $	108,330	68,340	49,160	36,330	n/a
Use of debt in $	63,030	38,140	21,480	10,760	n/a
Use of debt |no-coll in $	54,800	30,750	16,350	7,610	n/a
Use of debt |coll in $	79,240	52,710	31,570	16,970	n/a
Debt-to-capital ratio	0.23	0.09	0.03	0.01	0
Debt-to-capital ratio | no-coll	0.18	0.07	0.02	0.01	0
Debt-to-capital ratio | coll	0.25	0.10	0.03	0.01	0

ment rates, and in the "intensive" margin, whereby project size falls sharply with higher intermediation costs. With respect to the extensive margin, the overall self-employment rate falls from 12 to 9%, and these effects are fairly similar across households with low and high human capital levels. In the former case, the rate falls from 10 to 7%, and in the latter, from 16 to 13%. The fact that an increase in transactions costs generates a fall in self-employment rates is intuitive, and suggests that other factors are even more important in accounting for the high observed self-employment rates seen in LDCs.

Turning to the effect of borrowing costs on the intensive margin, Table 4 shows that the average size of self-employment projects falls substantially as intermediation costs rise. The fall is also nonlinear. An increase in intermediation costs from US-levels to 5% reduces the mean project size by approximately $20,000, while an increase in τ from 10 to 15% generates only minor changes. The proximate causes of the response of project size to financial frictions are twofold. First, as seen in Table 3, there are changes along the 'extensive' margin, whereby the self-employed borrow less frequently. Second, along the 'intensive' margin, Table 4 shows that when they do borrow, they borrow less. For example, under US-levels of transactions costs, more than half (51%) of the self-employed use credit, while none do when $\tau = 0.15$. In terms of magnitude, average debt declines from \$63,030 to \$0. The declines in borrowing and loan size are largest initially, consistent with the overall behavior of self-employment project size. Given that the cost of credit has a non-trivial impact on the use of credit, a natural outcome is that those who participate in self-employment must wait until they are able to (at least partially) internally finance their projects. This is reflected in Table 3 which shows the large increase in unconditional average age of the self-employed, which grows from approximately 30.6 to 33.7 years over the same interval of intermediation costs. Note also that along the dimension of mean age, the skilled are less affected than the unskilled.

Our results indicate that financial frictions, while important in altering the decisions of those already engaged in self-employment, are far less important in determining occupational choice itself. If anything, these financial frictions imply the opposite of what is observed in LDCs, in terms of the self-employment rate. Therefore, the heterogeneity in self-employment rates across countries is likely to be a direct consequence of the relative attractiveness of paid work, the effects of which we evaluate next.

4.2 The role of alternatives to self-employment

We evaluate next the importance of alternatives to self-employment, by varying wages in paid work. We set all model parameters *at current US levels*. In particular, we keep the intermediation costs fixed at $\tau = 0.0225$. We then vary median productivity in the corporate sector by multiplying the median US effective labor input by a fixed fraction at each age in the life-cycle, within the set $\mu^c(j,h) = \{\kappa\mu^c_{\text{US}}(j,h) | \kappa = 0.20, 0.33, 0.50, 0.80, 1.00\}$. This range covers a substantial portion of the variation in wages observed across LDCs and the developed world. Our findings are presented in Tables 5 and 6.[5]

The results suggest an extremely important role for alternatives to self-employment. In particular, when mean wages are one-fifth of current US levels, nearly all households choose self-employment (78%). Though this is an extreme case, the results are still instructive in showing how strongly wages affect self-employment decisions. Specifically, in Table 5, we see that even when wages are 80% of US levels, the model predicts an overall self-employment rate of 21%, which is substantially higher than the US. This prediction is consistent with self-employment rates observed in both Italy and Canada, where wages are roughly 80% of US levels (see, e.g. Kamhi and Leung 2005 for Canada, and Torrini 2002, for Italy). Moreover, at least in the case of Canada,

[5] Due to the lack of precise cross-country evidence on skill premia, we maintain a fixed skill premium across all experiments. That is, for a given κ, the ratio of skilled (college educated) wages to unskilled wages is held fixed at current US levels.

Table 5 The effect of wages under $\tau = 0.0225$ (US-level): extensive margin

	Mean wage as a % of the US level				
	20%	33%	50%	80%	100%
Self-employment rate	0.78	0.66	0.45	0.21	0.12
Self-empl. rate | no-coll	0.77	0.64	0.42	0.18	0.10
Self-empl. rate | coll	0.80	0.70	0.51	0.27	0.16
Probability of borrowing	0.48	0.45	0.47	0.51	0.51
Prob of borr | no-coll	0.50	0.47	0.51	0.57	0.56
Prob of borr | coll	0.45	0.40	0.40	0.40	0.40
Mean age of self-empl.	26.40	27.12	28.44	29.66	30.63
Mean age of self-empl. | no-coll	26.18	26.95	28.25	29.69	30.52
Mean age of self-empl. | coll	26.51	27.20	28.54	29.64	30.68

Table 6 The effect of wages under $\tau = 0.0225$ (US-level): intensive margin

	Mean wage as a % of the US level				
	20%	33%	50%	80%	100%
Project size in $	141,070	159,780	169,280	179,350	182,920
Project size | no-coll in $	120,010	136,790	143,020	148,430	155,240
Project size |coll in $	182,560	205,070	221,000	240,250	237,430
Wealth |borrowing in $	42,100	50,010	58,120	72,900	82,790
Wealth |borr and no-coll in $	36,210	42,670	48,920	61,560	69,830
Wealth |borr and coll in $	53,710	64,490	76,250	95,240	108,330
Use of debt	27,160	39,200	51,530	63,710	63,030
Use of debt | no-coll in $	23,170	34040	44,680	55,080	54,800
Use of debt | coll in $	35,030	49,370	65,030	80,720	79,240
Debt-to-capital ratio	0.25	0.24	0.25	0.25	0.23
Debt-to-capital ratio | no-coll	0.24	0.22	0.21	0.20	0.18
Debt-to-capital ratio | coll	0.26	0.26	0.27	0.28	0.25

it is plausible that credit market frictions are similar to the US, making wages a key factor.

A second result is that in general, as wages rise, so does the use of credit markets by non-college-educated households. Notably, Table 5 shows that when households earn only 1/5th of the US counterparts in paid work, 50% of non-college-educated households who enter self-employment borrow, while 57% do so when wages are 80% of US-levels. Meanwhile, for college-educated households, the payoff to paid work has the *reverse* effect, when wages are very low, more college-educated households borrow than when wages are high. This shows that the use of credit markets itself depends on wages, and should therefore be a source of caution when assessing the extent to which households are “credit constrained”.

A striking feature of the results in Table 5 is that the probability of borrowing is virtually constant, at roughly 50%, across wage levels. In contrast, 6 shows that the average size of loans declines by more than 50%, from approximately \$63,030 to roughly \$27,160, as wages fall from the benchmark to 20% of US levels. At the same time, the average wealth of borrowers also falls dramatically by more than 50%. These findings, taken together, suggest that while all households face the same marginal cost of external finance, the wealthy are willing to take on more non-state-contingent debt as they are better able to bear the increased risk of low project output than their poorer counterparts. Moreover, when wages are high, agents can accumulate wealth more quickly than otherwise. Given that default is prohibited, using debt finance is risky since repayment is mandatory regardless of project returns. Therefore, wealthy households will again be more willing to use debt than their poorer counterparts.

Another way to see the role of occupational choice is by observing that when paid work is unproductive, households choose self-employment earlier in the life-cycle. In particular, Table 5 shows that the mean age of the self-employed when wages are low (e.g. when wages are 20% or 33% of US levels) is up to nearly 4 years lower than in the US. Moreover, these effects are symmetric across skill groups.

The effect of wages in paid work is also important for the “intensive” margin of self-employment, as seen in Table 6, mean project size across skill groups falls with mean wages. The decreases are substantial, at around 23% in both cases. Thus, our model captures the qualitative regularity that households in countries with low average incomes also operate smaller projects when self-employed. Secondly, the median wealth of the self-employed grows with mean wages, which is natural, and in both cases roughly doubles when wages rise from 20% of US levels to 100% of US levels. Given the earlier finding from Table 5 that the mean age of the self-employed is approximately between 27 and 31 years of age, a regularity predicted by the model is the self-employed are always the “rich”. The preceding observation holds disproportionately when average wages are low. Our interpretation of this result is that even though self-employment provides an escape from low wages, it is *fundamentally risky*, and as a result is chosen primarily by the rich, especially when wages are low relative to the US.

It is important to recognize the limits of our model, particularly for understanding within-country experiences over time. For example, the U.S. self-employment rate in 1910 has been estimated at 16% (see Fairlie and Meyer 2000) even though wages at that time were equivalent to those currently prevailing in LDCs, where self-employment rates are much higher. Size-dependent policies, such as those documented in Parente and Prescott (2000) and Güner et al. (2008), appear to be quite important in keeping self-employment rates “unnaturally” high by deterring large-scale “corporate” establishments. Future work allowing for richer interactions between occupational choice, establishment-size policy, and productivity is therefore likely to be valuable.

4.3 Do the effects of financial frictions depend on the level of wages?

The results so far suggest that financial intermediation plays a secondary role to wages in the corporate sector in determining the self-employment rate, but matters

Table 7 The effect of transactions costs under low wages: extensive margin

	Transaction costs, τ ($\tau_{US} = 0.0225$)				
	0.0225	0.05	0.075	0.1	0.15
Self-employment rate	0.65	0.57	0.52	0.48	0.46
Self-empl. rate | no-coll	0.63	0.54	0.50	0.46	0.43
Self-empl. rate | coll	0.68	0.62	0.56	0.54	0.54
Probability of borrowing	0.46	0.35	0.23	0.17	0.06
Prob of borr | no-coll	0.48	0.37	0.25	0.19	0.06
Prob of borr | coll	0.42	0.30	0.19	0.13	0.05
Mean age of self-empl.	27.18	28.23	29.23	29.96	30.89
Mean age of self-empl. | no-coll	27.12	27.93	29.34	29.82	30.30
Mean age of self-empl. | coll	27.21	28.39	29.18	30.03	31.19

Table 8 The effect of transactions costs under low wages: intensive margin

	Transaction costs, τ ($\tau_{US} = 0.0225$)				
	0.0225	0.05	0.075	0.1	0.15
Project size in \$	158,150	132,380	123,520	112,520	112,790
Project size | no-coll in \$	137,200	109,210	103,390	96,220	90,620
Project size | coll in \$	199,420	178,010	163,150	144,620	156,440
Wealth | borrowing in \$	48,660	33,270	25,620	19,890	12,660
Wealth | borr and no-coll in \$	41,400	27,990	22,110	17,670	10,610
Wealth | borr and coll in \$	62,970	43,670	32,530	24,270	16,700
Use of debt in \$	39,720	27,290	20,460	15,220	8,560
Use of debt | no-coll in \$	34,450	23,410	17,720	13,070	7,590
Use of debt | coll in \$	50,100	34,920	25,850	19,460	10,460
Debt-to-capital ratio	0.25	0.18	0.12	0.08	0.03
Debt-to-capital ratio | no-coll	0.23	0.16	0.10	0.07	0.02
Debt-to-capital ratio | coll	0.27	0.20	0.13	0.09	0.03

significantly for project size. However, will financial frictions have much stronger effects on self-employment when wages are much lower than US levels? To evaluate this question, we study outcomes obtaining under various premia for borrowing in an economy where mean wages in paid work are set to 1/3rd of their US level. Tables 7 and 8 present the results. First, the effects of financial intermediation costs on self-employment rates are substantially larger, in terms of percentage point changes, when wages are lower than US levels. Comparing outcomes in Table 3 with those in Table 7 demonstrates this result. For both skill groups, the absolute size of the fall in the self-employment rate is on the order of 14-percentage points for the college-educated and 20-percentage points for the unskilled when wages are 1/3rd of US-levels. By contrast, under US wage levels, the fall was only 3-percentage points. The model therefore suggests that financial frictions are much more pivotal in driving self-employment decisions when alternatives to self-employment are poor. In part, this arises from the fact that when overall wages are low, it is difficult to accumulate enough wealth to run projects efficiently. A feature consistent with this force is seen in the larger impact of financial intermediation costs on the mean age of the self-employed, as seen by comparing Table 7 with Table 3. In the former, wages are low, and the mean age grows from approximately 27 to 31 years of age. In the latter, when wages are high, the rise is smaller, from 31 years of age to 34. Additionally, comparing the results in Tables 3 and 4 with those in Tables 7 and 8 shows, interestingly, that while high borrowing premia eliminated borrowing under high wages (see Tables 3 and 4), they do not do so under low wages, as seen in Tables 7 and 8. In sum, the findings in this section suggest that the effects of financial frictions are likely to be substantially more important in self-employment decisions in low-wage economies. Furthermore, transaction costs affect self-employment rates *only* at particularly low wages. The drop in project size changes dramatically as well. Specifically, when transaction costs rise from US levels to 0.15, project size under US wagesfalls by 15%, as seen in Table 4, while Table 8 shows that under low wages, the drop is much larger, at roughly 29%.

4.4 Do the effects of wages in paid work depend on the level of financial frictions?

Having documented that wage levels matter for the importance of costs of financial intermediation, we evaluate the extent to which the converse is true. Namely, does the role played by alternatives to self-employment hinge on credit conditions? The answer, in a nutshell, is "no." As seen by comparing the results in Tables 9 and 10 with those in Tables 5 and 6, we see that in both cases, increases in overall wages produce rapid drops in self-employment, irrespective of the costs of borrowing. Table 9 makes clear that the probability of borrowing is 9% when wages are 20% of the US level, but falls to 0% under US wages. By contrast, under benchmark transactions costs of $\tau = 0.0225$, we showed earlier in Table 5 that wage levels had virtually no effect on the likelihood of borrowing.

Table 9 The effect of wages under $\tau = 0.15$: extensive margin

	Mean wage as a % of the US level				
	20%	33%	50%	80%	100%
Self-employment rate	0.61	0.46	0.30	0.14	0.09
Self-empl. rate ∣ no-coll	0.59	0.42	0.26	0.11	0.07
Self-empl. rate ∣ coll	0.67	0.53	0.38	0.19	0.13
Probability of borrowing	0.09	0.06	0.03	0.00	0.00
Prob of borr ∣ no-coll	0.08	0.07	0.03	0.00	0.00
Prob of borr ∣ coll	0.10	0.05	0.02	0.01	0.00
Mean age of self-empl.	29.09	30.84	32.27	33.47	33.42
Mean age of self-empl. ∣ no-coll	28.57	30.31	31.96	33.08	33.29
Mean age of self-empl. ∣ coll	29.36	31.10	32.43	33.67	33.49

Table 10 The effect of wages under $\tau = 0.15$: intensive margin

	Mean wage as a % of the US level				
	20%	33%	50%	80%	100%
Project size in $	94,210	108,710	125,340	141,930	157,840
Project size | no-coll in $	75,880	86,280	99,090	110,960	128,050
Project size | coll in $	130,300	152,890	177,040	202,920	216,520
Wealth | borrowing in $	8,350	12,590	14,810	9,240	n/a
Wealth | borr and no-coll in $	6,490	10,530	13,070	5,690	n/a
Wealth | borr and coll $	12,020	16,660	18,220	16,230	n/a
Use of debt in $	7,280	8,580	7,640	3,000	n/a
Use of debt | no-coll in $	6,900	7,590	6,350	2,440	n/a
Use of debt | coll in $	8,040	10,530	10,170	4,100	n/a
Debt-to-capital ratio	0.05	0.03	0.01	0.00	0.00
Debt-to-capital ratio | no-coll	0.05	0.02	0.01	0.00	0.00
Debt-to-capital ratio | coll	0.05	0.03	0.01	0.00	0.00

Therefore, the natural question is "when transactions costs are high, why do low wage households borrow more often and in larger amounts, than high wage households?" First, in the case where project risk could be diversified, the efficient scale of the project will fall with higher transactions costs, as long as any borrowing occurs. In low-wage settings, many households will also hold relatively low wealth levels. These low-wealth individuals, if they do not borrow, will have projects with relatively high expected marginal product. Therefore, borrowing remains attractive, even under high transactions costs. Conversely, when wages are high, it is relatively easy for households to accumulate enough wealth to pursue self-employment projects. These households are, as a result, sensitive to the premium on external finance, and therefore choose not to borrow.

4.5 A common productivity level in paid work and self-employment

In this paper, we have assumed throughout that the technology and production risk governing self-employment are identical across countries. As a consequence, wage differentials across countries do not imply corresponding differences in the productivity of self-employment. A natural alternative to consider is a setting in which there is a positive correlation in productivity across sectors. We study the polar case by assuming that productivity in self-employment falls by the same proportion as productivity in corporate-sector work. One can then interpret changes in productivity as changes to a single "aggregate productivity" differential between the US and LDCs. We report the results in Tables 11 and 12. The main finding is that this assumption generates completely counterfactual outcomes with respect to cross-country variation in self-employment rates. In fact, once productivity in self-employment is lowered below 40% of the US level, the model predicts *no* self-employment at all!

Table 11 The effect of common productivity in paid work and self-employment: extensive margin

	Aggregate productivity levels (US = 100%)				
	20%	33%	50%	80%	100%
Self-employment rate	0	0	0.00	0.02	0.12
Self-empl. rate ǀ no-coll	0	0	0.00	0.02	0.10
Self-empl. rate ǀ coll	0	0	0.00	0.03	0.15
Probability of borrowing	n/a	n/a	0.02	0.23	0.51
Prob of borr ǀ no-coll	n/a	n/a	0.03	0.26	0.56
Prob of borr ǀ coll	n/a	n/a	0.02	0.17	0.40
Mean age of self-empl.	n/a	n/a	33.30	33.18	30.63
Mean age of self-empl. ǀ no-coll	n/a	n/a	32.60	32.75	30.52
Mean age of self-empl. ǀ coll	n/a	n/a	33.65	33.40	30.68

Table 12 The effect of common productivity in paid work and self-employment: intensive margin

	Aggregate productivity levels (US = 1)				
	20%	33%	50%	80%	100%
Project size in $	n/a	n/a	58,320	107,590	182,920
Project size ǀ no-coll in $	n/a	n/a	46,120	80,380	155,240
Project size ǀ coll in $	n/a	n/a	82,370	161,170	237,430
Wealth ǀ borrowing in $	n/a	n/a	12,720	45,200	82,790
Wealth ǀ borr and no-coll in $	n/a	n/a	10,090	36,700	69,830
Wealth ǀ borr and coll $	n/a	n/a	17,900	61,950	108,330
Use of debt in $	n/a	n/a	3,580	22,650	63,030
Use of debt ǀ no-coll in $	n/a	n/a	1,780	18,750	54,800
Use of debt ǀ coll in $	n/a	n/a	7,120	30,330	79,240
Debt-to-capital ratio	n/a	n/a	0.00	0.07	0.23
Debt-to-capital ratio ǀ no-coll	n/a	n/a	0.00	0.05	0.18
Debt-to-capital ratio ǀ coll	n/a	n/a	0.00	0.08	0.25

A second key finding is that the size of businesses shrink as the economies are subjected to a common percentage decrease in productivity. In turn, the relative income of the self-employed in LDCs is not the same as in developed countries-even in the presence of an identical technology. The reason for the reduction in project size is that lower wages in paid work imply a reduced ability to self-finance large projects. As a result, to operate such projects, households must borrow. Interestingly, they do not; credit use is substantially lower in the low-common-productivity cases, and as in turn, agents run fewer and smaller business projects. The reduction in credit use cannot be because of intermediation costs, as they are held fixed in this experiment. Instead, the reluctance of the household to borrow arises because such households face risk, and will be forced to repay large debts, even when output is lower than expected.

Notice that both the benchmark model and the preceding experiments generated smaller mean project size, and in turn, mean self-employment income in LDCs. However, we do not know of clear empirical evidence on the relative incomes of the self-employed across countries. Future empirical work documenting outcomes among the self-employment in LDCs, especially facts regarding relative mean income *conditional* on project size, will help clarify the precise nature of productivity differentials across sectors and countries.

A more general argument against a high correlation of productivity between self-employment and corporate sector productivity is that intuitively, occupational choices should be driven by *relative* attractiveness, not absolute levels. As a result, an identical reduction in productivity across these sector should not by itself lead to large changes in occupational choices. In particular, with a perfectly positive correlation, one might expect to recover US self-employment rates. Our finding that self-employment rates are actually lower in LDCs in this case therefore suggests that such a correlation is implausible.[6] In addition to the preceding, a more direct source of evidence for sector-specific productivity difference is the widespread presence of policies aimed at discouraging large-scale operations (such as size restrictions). By their nature, such policies disproportionately affect productivity in the paid-work sector, *without* affecting productivity in the self-employment sector. Güner et al. (2008) document in detail the implicit and explicit distortions imposed on large businesses in many countries and find that such distortions are important for observed cross-country income variations.

While we have focused on cross-variations in self-employment activity at a point in time, the historical record for the US indicates that the self-employment rate and wages in paid work indicate more correlation than our benchmark model assumes. In particular, Fairlie and Meyer (2000) report that as of 1910, the white self-employment rate was only about 16%, even though US per-capita GDP at the time was approximately one-fourth of current levels (see Maddison 1983). Relatedly, in the past three decades, the US self-employment rate has not changed, even though average wages (though not median wages) have risen.[7] While these observations may appear to suggest a stronger correlation in productivity across sectors than is assumed here, we find the alternative interpretation of Güner et al. (2008) attractive, given the clear absence of distortionary size-dependent policies in the US over the last century.

5 Concluding remarks

The main message of this paper is that the broad regularities of self-employment across countries are consistent with a setting in which a common self-employment

[6] Of course, one theoretical possibility is that if self-employment in LDC is far less risky than in developed ones, LDC households may continue to choose it frequently-even when LDC self-employment productivity is similar to LDC corporate-sector productivity. We do not think that this is an empirically relevant case.

[7] We are grateful to an anonymous referee for drawing our attention to this fact.

technology is available worldwide, but where financial intermediation and alternatives in “paid” work differ greatly. In particular, our model generates substantially higher self-employment rates in countries with low wages, but suggests that intermediation costs are critical as well. Specifically, when wages are very low relative to the US, and intermediation costs are held at US levels, far too many households choose self-employment. Moreover, a interesting conclusion that follows from the preceding findings is that high rates of self-employment do not imply well-functioning credit markets. In fact, we show that given observed wage differentials in paid work, more severe frictions in financial markets are required to account for the stylized facts on relative self-employment rates and establishment size in low-wage, rather than high-wage, settings. Future work should therefore confront the implications of our model with data for specific policy choices on the availability, characteristics, and price of credit.

Our model is also successful in producing the regularity that mean wages in paid work are positively correlated with project size; this result obtains even though the technology for self-employment is held to be common across countries. We find also that though intermediation costs are very important for the use of credit, it is relative wages in paid work, rather than a premium for borrowing, that matter most for the overall rate of self-employment. Our model suggests that the risk of production in self-employment acts as a deterrent, especially in cases where wages are particularly low relative to the US. Lastly, though we motivated our inquiry with reference to US-LDC comparisons, our experiments reveal that our model is able to replicate outcomes for some developed countries as well.

In order to most clearly isolate the roles of credit frictions and alternativ es to self-employment, we restricted attention to a corporate sector production technology that was linear in labor. However, given the relatively large changes to occupational choices arising from changes in credit transactions costs and corporate-sector productivity, such an assumption may lead to an overstatement of the impact of these mechanisms. In their related work, Antunes et al. (2008) find, comparing partial- and general-equilibrium versions of their model, that there may be important general equilibrium feedback effects which limit equilibrium responses. We leave this for future work.

Perhaps the most serious barrier to progress on understanding self-employment activity across countries (especially LDCs) is the lack of definitive “stylized” facts. Our model makes many predictions regarding the scale, timing, and income risk of self-employment, as functions of *potential* observables such as age, wealth, and cost of external finance. For example, the arithmetic of high self-employment rates and low per-capita income in LDCs certainly implies that mean project size is smaller in the latter than in developed countries, just as our model predicts. Yet, it is also not possible, given current data, to definitively compare our model's predictions for the precise nature of productivity and riskiness of self-employment with those prevailing across a wide range of countries. Moreover, while we assume a common technology in self-employment it may well be the case that the underlying technologies available to the would-be self-employed differ substantially as well. Even abstracting from agricultural self-employment, where such differences do seem plausible, LDC households may face difficulties accessing physical capital that reflects state-of-the-art technology, such as computers. Detailed empirical work is therefore perhaps the most important next step in the process of selecting the appropriate model of self-employment.

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